DOCUMENT RESUME

ED 096 369 UD 014 533

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TITLE The Utility and Implications of 1970 Census Data in Predicting Achievement and Assessing Effects of Concentrated Urban Poverty in Chicago.
INSTITUTION Missouri Univ., Kansas City. Center for the Study of Metropolitan Problems in Education.
PUB DATE Sep 74
NOTE 40p.

EDRS PRICE MF-$0.75 HC-$1.85 PLUS POSTAGE
DESCRIPTORS *Academic Achievement; *Census Figures; City Problems; Depressed Areas (Geographic); Economically Disadvantaged; Ghettos; *Poverty Research; *Predictive Measurement; Public Schools; Research Methodology; Statistical Analysis; Surveys; Urban Population; *Urban Schools
IDENTIFIERS Illinois

ABSTRACT

The purpose of this report is to describe the results of a series of studies conducted on the relationships between census information and school achievement in the Chicago Public Schools. These studies were designed as an exploratory investigation to determine the extent to which grade-level achievement averages could be predicted using data from the third count (block statistics) and fourth count (tract statistics) of the 1970 Census, without including data on race or ethnicity. In particular, one of the original purposes was to determine whether evidence could be found of a differential effect on school achievement associated with concentrated urban poverty. The results of the study suggest that differences in achievement among the schools in the sample are associated with differentials in the concentration of poverty and poverty-related characteristics. Stated differently, whether poverty and its correlates are relatively concentrated (or absent) in the urban neighborhoods in the sample is related to the degree to which achievement scores in local schools are unexpectedly different than would be predicted on the basis of a linear relationship between poverty and achievement. (Author/JM)

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THE UTILITY AND IMPLICATIONS OF 1970 CENSUS DATA IN PREDICTING ACHIEVEMENT AND ASSESSING EFFECTS OF CONCENTRATED URBAN POVERTY IN CHICAGO

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The research reported herein was assisted with grants from the Kansas City Association of Trusts and Foundations and the U. S. Department of Health, Education and Welfare.

UD 014533

September 1974

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ACKNOWLEDGMENTS

We would like to thank the following individuals for indispensable assistance they provided in carrying out this project:

Mrs. Marjorie Thoelke for help in innumerable aspects of the study.

Dr. Herbert Walberg and Dr. Cris Kukuk for advice on processing and analyzing the data.

Dr. Irving Brauer, Dr. Elmer Casey, Robert Kelley, Thomas Teraji, and Frank Ward of the Chicago Public Schools for helping us obtain and understand the school data.

Joseph Joyce for continuing efforts in computer programming and analysis.

Ms. Jane Sadell for help in extracting the census data.

Ms. Brenda Faskin and Ms. Norma Hill for help in processing the information and preparing it for analysis.

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INTRODUCTION

The purpose of this report is to describe the results of a series of studies we have been conducting on the relationships between census information and school achievement in the Chicago Public Schools. These studies were designed as an exploratory investigation to determine the extent to which grade-level achievement averages could be predicted using data from the third count (block statistics) and fourth count (tract statistics) of the 1970 Census, without including data on race or ethnicity.

The first chapter of the report summarizes the results of our explorations with third count data. Fourth-count data, reported in the second chapter, turned out to be as useful for predicting achievement as were the block statistics. Our major conclusion is that a limited number of census variables, easily available in government census publications, account for seventy to eighty percent of the variance in elementary school achievement means in Chicago. Implications and additional findings are discussed in the concluding chapter.

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I. THIRD COUNT ANALYSIS

Background and Purpose

In June of 1969, Walter I. Garms and Mark C. Smith completed a study for the New York State Educational Conference Board in which they studied achievement in 45 schools in a stratified sample of differing size cities from various parts of New York State.[1]

Reviewing previous research, they pointed out that socioeconomic background, home environment, and related measures have been found to correlate more highly with achievement than do school-related variables. In addition to showing that socioeconomic status of a student body is a relatively good predictor of achievement, Garms and Smith argued, this finding also suggests that socioeconomic and related variables can indicate whether students in a given school are particularly disadvantaged educationally and thus can serve as a measure of educational need in state aid formulas. Thus the purpose of their study was "to develop a rational and practical measure of educational need and to suggest ways in which such a measure might be incorporated into the method of distributing state financial aid."

After considering a number of possible variables, Garms and Smith decided to work with data on the following student background measures: racial and ethnic background; broken homes; welfare; parental education; overcrowded housing; and mobility. (Several of these variables were measured with two or more alternative sub-variables.) Next they obtained data on achievement in reading and arithmetic and appropriate background data on twenty fourth-grade students in each school in their sample, and then used multiple regression techniques to determine which sets of variables provided the most powerful and economical prediction of achievement levels in those schools. Based on a list of criteria for acceptability of regression equations plus an analysis of residuals, they chose three equations which predicted 70 to 71 percent of the variance as their best predictor equations. Each of the three equations contained the variables Percent Negro; Percent Puerto Rican; and Average Years of Schooling of Father Where Present, Otherwise Mother. In addition, two equations contained the variable Mobility.

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[1] Walter I. Garms and Mark C. Smith, "Development of a Measure of Educational Need and Its Use in a State School Support Formula." Albany, New York: New York State Educational Conference Board, June 1969. The results of this study also are reported in Walter I. Garms and Mark C. Smith, "Educational Need and Its Application to State School Finance," The Journal of Human Resources, v. 5, no. 3 (Summer 1970), 304-317 and in James A. Kelly, "Resource Allocation and Educational Need," Education and Urban Society, v. 11, no. 3 (May 1970), 251-176.

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Although Garms and Smith's study constituted an important contribution to thinking and research in educational finance, we believed it raised certain issues and difficulties which required additional study. In particular, we felt that there would be a number of political and administrative problems in using data incorporating measures of race and ethnicity into state school aid formulas. Moreover, several previous studies on determinants of achievement have indicated that race and ethnicity add little to the prediction of achievement after suitable controls are imposed for socioeconomic background and home environment. In addition, it was possible that the variables Percent Negro and Percent Puerto Rican might very well be serving as proxy measures for contrasts between conditions in high density, poverty neighborhoods in large urban centers on the one hand as compared with conditions in less socially disorganized communities on the other. That is, it was possible that the schools with high proportions of Negro or Puerto Rican pupils would tend to be schools which are located in high density, very low-income poverty neighborhoods in cities in New York State. Since there is reason to believe that conditions in high density, poverty neighborhoods constitute a special set of circumstances in which "threshold" limits involving the operation of social controls have been exceeded, and since social disorganization beyond given threshold levels may lead to rapid deterioration in social institutions such as the schools, it seemed possible that the equations developed in Garms and Smith's linear regression analysis were picking up effects of dense, urban poverty rather than race or ethnicity per se.

Accordingly, we obtained access to Garms and Smith's data and carried out a re-analysis to determine whether a non-linear approach omitting the variables Percent Negro and Percent Puerto Rican could account for as much of the variance as had been predicted in the original study. This was done by including squared and cubed terms and interaction terms for most of the remaining variables.

The results of this analysis were sufficiently encouraging to warrant additional research for the specific purpose of exploring the possibility of using socioeconomic variables (but not race or ethnicity) for state aid formulas or the general purpose of learning more about the effects of concentrated urban poverty on school achievement. One of our equations, for example, showed that the five variables welfare, welfare cubed, father's schooling, welfare x broken homes, and broken homes x father's schooling accounted for 71% of the variance in arithmetic achievement among the schools in Garms and Smith's sample. For reading achievement, 59% of the variance among schools was accounted for by the six variables welfare, welfare cubed, foreign language spoken in the home, broken homes cubed, mobility, and broken homes x mobility. In the full stepwise equation, the cubed terms for welfare and broken homes were more powerful predictors of achievement than were the squared terms for these variables; this finding suggests that social disorganization

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as measured by percent on welfare and percent from broken homes may have a particularly detrimental impact on school achievement in neighborhoods where these percentages are extremely high.

This re-analysis, however, could not be interpreted as being more than suggestive of the need for further research. Due to problems in the original study, particularly skewedness in the data and difficulties in the measurement of variables, neither Garms and Smith's linear analysis nor our own nonlinear analysis could be viewed with much confidence in the absence of more refined investigations with other samples. In the present study, accordingly, our major purpose is to determine how much of the variance in elementary school grade-level achievement averages in one big city can be accounted for by student background variables (as indexed in the Census) excluding race and ethnicity.

It was decided to collect data in Chicago, primarily because school-by-school ability and achievement information was available there to correlate with 1970 Census data on neighborhoods. One reason for obtaining a sample of schools from a single big city school district is to control as much as possible for district-level variations in test administration, promotion policies, and other variables that might obscure relationships in multi-district comparisons. The achievement and student background variables chosen for inclusion in this study are described in the following section on Methods and Procedures.

Methods and Procedures

After obtaining a map showing the location of elementary schools in Chicago,[2] we selected a geographically- and socially-diverse sample of approximately 150 elementary schools which included grades one through six.[3] Since data were available on the racial and ethnic composition of Chicago elementary schools, and since one of the investigators was personally familiar with schools in Chicago, it was not difficult to make sure that the sample included schools which varied widely in racial and ethnic composition. A special effort

[2]We would like to acknowledge and express appreciation for the kind cooperation extended by many Chicago school officials, particularly the following:

Irving Brauer - Office of Operations Analysis
Dr. Elmer Casey - Director of Pupil Evaluation and Studies
Robert Kelley - Director of Administrative Research
Thomas Teraji - Director of Attendance Area Studies
Frank Ward - Division of Pupil Evaluation and Studies

[3]There is much variation in organizational patterns in the Chicago Public Schools. In addition to pre-school centers there are a number of primary-grade centers and K-8 schools, as well as other variations. Schools included in the preliminary sample ranged from K-6 to K-8.

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was made to include predominantly black schools in relatively high status neighborhoods and predominantly white schools in relatively low status neighborhoods as well as particularly high and low achieving schools of whatever composition, in order to facilitate later analysis examining the relationships between social status, race and ethnicity, and school achievement.

Next, knowledgeable school district officials were consulted in order to determine whether special circumstances existed which might make it inappropriate to include any of the schools in the preliminary sample. Approximately fifteen schools were eliminated at this stage either because they did not serve surrounding neighborhood populations to the same extent as do most elementary schools in Chicago[4] or because critical problems usually involving school-community relations had kept them in constant turmoil during the year achievement data had been collected which were to be used in the study.

After the preliminary sample had been constituted in this way, official maps showing the attendance boundaries of elementary schools in Chicago were obtained. Using metropolitan maps of Chicago produced by the U. S. Census Bureau, a list was made showing the block groups and census tracts within each school's attendance area. At this stage in the selection process, only block groups which were entirely within and census tracts which visual inspection indicated were at least 80% within a given school's attendance area were included in the list of block groups and tracts for that school. Using these lists, it now was possible to extract information on block groups contained in the third count of the 1970 Census and information on census tracts contained in the fourth count.

However, to make sure that we would obtain as close as possible a match between student achievement data on the one hand and socioeconomic data on the neighborhoods in which students lived on the other, three additional steps were taken in selecting the final sample of schools. First, "spot" maps showing the actual block location of students enrolled in the schools in the sample as of the spring of 1970 were obtained and used to superimpose "effective" school boundaries (i.e., the area from which schools actually draw most of their students as contrasted with the official boundary lines) upon the larger metropolitan map showing the location of census tracts

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[4] Schools eliminated on this basis included several involved in a busing program to relieve overcrowding on the west side and several others which were special education centers.

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and block groups.[5] Second, 145 schools were selected from within the preliminary sample which visual inspection indicated had the most satisfactory "fit" between effective attendance area and census tract boundaries. Third, block group data from the third count (see below) were obtained for these schools and a comparison was made between data on demographic variables available from the Census and data on student population characteristics during the same year (1970). Comparing the two types of data, 21 schools were found in which the percentage of white students in the school was 15 percentage points or more smaller than the comparable percentage in the attendance area. On the assumption that special circumstances existed in these communities which made it inadvisable to view the school population as representative of its neighborhood (for which census data would be related to school achievement data),[6] these schools were eliminated. In addition, two schools were eliminated because there were less than 1,000 people on the respective blocks for which we extracted third count data for their neighborhoods. Finally, seven schools were eliminated because achievement data were not available for all the school years to be analyzed and one was eliminated because of mistakes in recording and punching the data on IBM cards. Thus, 114 schools remained to comprise the basic sample.

Third Count Census Data

The study described in this section utilized the third count of the decennial census conducted in the City of Chicago by the U. S. Bureau of the Census in the spring of 1970. The third count is the only tabulation that provides data by blocks - the smallest unit for which data are collected and released.

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[5] In determining "effective" school attendance areas, several decision rules were developed after preliminary study of attendance patterns at a few schools. First, we used data only on students in grades 1 through 6. Second, we generally did not include a block unless at least two students were enrolled in the school or the next block further out had at least three students enrolled. Third, slight departures from these criteria were tolerated when doing so made the effective attendance area of a school much more compact than would have been the case had the criteria been universally applied.

[6] Special circumstances which might account for this discrepancy between the school data and the community data include: a particularly high percentage of white students may attend private and parochial schools; the white population may be relatively old and without children in the home, as often happens in neighborhoods undergoing racial transition; or residential turnover may be so rapid that school and census data collected even a few months apart may not be easily comparable.

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Data were extracted from computer tapes at the Demographic Data Center, Technical Services Division, at the Columbia campus of the University of Missouri. The computer programs developed for this purpose used lists of the blocks (by census tracts) we had selected to represent school neighborhoods in accordance with the procedures described above. The computer print-outs showed percentages based on the total number of persons, houses, etc. (depending on the variable) in the blocks chosen for each particular school. In some cases variables were defined in the same way as they are presented in the census; in other cases, we designated our own variables based on raw data from several census categories.

Following this procedure, we selected and constructed seventeen variables describing neighborhood conditions in our 122-school sample. Several of these variables seemed particularly promising as indicators of concentrated urban poverty (e.g., Variable 17, below). The seventeen census variables are shown in Table 1.

Achievement Data

Achievement data used in this study are for schools with grades 1-8 or 1-6, depending on each school's organization. Tests for which data were obtained are as follows: Readiness at entrance to first grade: Metropolitan Readiness Test; Fourth Grade: Kuhlman-Anderson Test and Metropolitan Achievement Battery, Form B. Reading; Sixth Grade: California Short-form Test of Mental Maturity, 1957-S Form and Metropolitan Achievement Test, Reading. Q2 scores represent the median in a given school, and Q3 scores represent the point that divides the top quarter from the remaining three quarters. On nationally-standardized tests, the Q2 national "norm" is 50 and Q3 norm is 75. Scores listed as "4th Grade " actually represent data obtained at the end of the primary-intermediate transition (3rd) grade. Achievement data were collected for the 1968-1969, 1970-1971, and 1971-1972 school years.

Analysis and Results

The first step in our analysis of the data was to obtain a correlation matrix showing the association between all the neighborhood (census) and school variables in the study.[7] This matrix enabled us to pick out the best combinations of census variables for predicting school achievement scores--that is, the census variables which were most highly correlated with achievement but least inter-correlated among themselves.

Preliminary stepwise regression analyses also were carried out at this point. The regression data indicated that there was considerable

[7]Most of the analysis reported in this chapter was carried out on the University of Missouri - IBM 370-65 Computer.

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TABLE 1

Third Count Variables

	Variable	Mean	Standard Deviation
1.	Per Cent Negro	41.38	47.80
2.	Per Cent Negro and Other	42.92	46.91
3.	Per Cent of Females Separated	6.31	5.76
4.	Per Cent Owner Occupied of Total Occupied Units	36.65	27.81
5.	Per Cent of Housing Units Which Are One-Unit Structures	27.32	29.36
6.	Per Cent of Units with 6 Persons or More	13.50	8.16
7.	Per Cent of Occupied Housing Units 1.51 or More Persons Per Room	3.66	3.47
8.	Per Cent of Negro Renter Occupied Units with 1.51 or More Persons Per Room	2.64	3.95
9.	Per Cent of Housing Units Not With Flush Toilets for Household Only	3.12	4.51
10.	Per Cent of Occupied Housing Units Worth Less Than $9999	64.70	36.17
11.	Per Cent of Renter-Units with Rent Less Than $59	23.57	28.82
12.	Per Cent of Renter-Units with Rent Less Than $99	56.59	27.31
13.	Per Cent of Housing Units Vacant Six Months or More	2.41	3.21
14.	Per Cent of Occupied Units with Female Head Families	15.70	9.91
15.	Per Cent of Families Which Lack 1 or More Plumbing Facilities	2.08	2.06
16.	Per Cent of Occupied Units with Negro Occupants Lacking 1 or More Plumbing Facilities and Having 1.01 or More Persons Per Room	.14	.30
17.	Per Cent of Population in Units Lacking 1 or More Plumbing Facilities and with 1.01 or More Persons Per Room	.72	.82

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consistency in the functioning of most of the census variables in the sense that these variables generally entered regression equations with roughly the same weight and direction of influence and approximately in the same order at differing grade levels. This finding is important if one hopes to identify census variables which can be used to obtain a good prediction of school achievement in future replications without repeating all the preliminary work necessary in this exploratory study.

Our preliminary analysis also indicated that errors had occurred in extracting neighborhood variables dealing with the value of housing (variables 10, 11, and 12, Table 1) from the Third Count Census Tape. For this reason, neither these variables nor interaction terms including any of them could be utilized in subsequent analyses reported in this paper. Thus we had to proceed without the most direct measures of community income level to be found in the third count.

At this point we also excluded variables designating race (variables 1, 2, 8, and 16, Table 1), in order to determine how much achievement variance could be explained without direct measures of race and ethnicity. Using the remaining ten variables, a series of stepwise as well as forced order regression equations were computed. In several of these equations, six or seven census variables accounted for 80 percent or more of the variance in sixth-grade reading achievement scores. However, because we wanted to select an equation that would include fewer variables as well as be stable across years and grade levels, several additional equations were constructed using only three or four census variables with their squared and interaction terms. The equation which best met the criteria of a) high percentage of variance accounted for, b) high stability, and c) minimum number of variables, included the following three variables and two interaction terms: Per Cent of Females Separated, Per Cent of Occupied Units with 6 Persons or More, Per Cent Owner Occupied of Total Occupied Units, Per Cent of Females Separated x Per Cent of Occupied Units with 6 Persons or More, and Per Cent of Females Separated x Per Cent Owner Occupied Units with 6 Persons or More. Data for reading achievement using the forced order regression equation with the five terms in the order given above are shown in Table 2.

As shown in Table 2, the percentages of variance in sixth-grade reading achievement scores accounted for by the three census variables and the two interaction terms vary from 63 percent for 1971-1972 reading readiness to 80 percent for sixth grade Q3 scores. The data suggest that census data are slightly more accurate in accounting for variance in achievement scores collected within a year of the time the census was carried out than in accounting for achievement a year or more earlier or later. In every case but one (i.e. 1971-1972 Q3 scores at the sixth grade), the amount of variance explained in 1970-1971 achievement scores is from three to eleven percentage points greater than is true for 1968-1969 and 1971-1972 achievement data. More research needs to be conducted to determine how much loss of

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TABLE 2

Per Cent of Variance in Reading Achievement Accounted for by Three Selected Third Count Census Variables and Two Interaction Terms (114 Schools)+

	Year		
Reading Achievement Score	1968-1969	1970-1971	1971-1972
Q2, 4th Grade	64	75	64
Q2, 6th Grade	70	79	76
Q3, 6th Grade	73	79	80
Readiness for first grade	69	69	63

+The percentages are the squares of the multiple correlations corrected for sample size. The regression analyses reported in this table used forced-order equations with the independent variables entered in the following order: Per Cent of Females Separated, Per Cent of Occupied Units, Per Cent of Females Separated x Per Cent of Occupied Units with 6 Persons or More, and Per Cent of Females Separated x Per Cent Owner Occupied Units with 6 Persons or More.

accuracy may be involved in accounting for achievement two or more years before or after 1970 census data were collected.

Other related conclusions that emerged from the regression analyses we carried out using various combinations of census variables were as follows:

1. Equations using additional census variables referring explicitly to race generally did not account for substantially more of the variance in achievement scores than did equations using only the census terms shown in Table 2. When nine other census variables including several designating race were part of a non-forced equation also including three of the four variables shown in Table 2, only two added more than .6 of one per cent to the explanatory power of the equation. Thus, with regard to the goal of predicting elementary school achievement scores in Chicago from census data, there is little to be gained by including variables referring explicitly to race.

2. In almost all non-forced (stepwise) equations regardless of grade level (4th or 6th), type of achievement score (Q2 or Q3), or number of census variables included in the equations, the variables shown in Table 2 either were the first three or were among the first four to enter. Thus it seems clear that these three variables have high utility for predicting grade-level achievement scores among Chicago elementary schools. When the seven best remaining census variables (as indicated by inspection of the correlation matrix were then entered

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into a series of non-forced equations utilizing various of the dependent achievement variables, no variable consistently added (in the predicted direction) as much as three percent to the explainable variance.

3. At the 6th grade level, the census variables shown in Table 2 predicted Q3 scores better than Q2 scores, but the opposite was true at the 4th grade level. Thus there was no reason to conclude that either Q3 scores or Q2 scores are inherently superior to the other in using census data to account for the variance in school achievement means.

4. The percentage of variance in learning ability (I.Q.) scores accounted for by census variables generally was as high or even a little higher than was true with respect to reading achievement scores. For example, the census terms shown in Table 4 accounted for 78 percent of the variance in SLA Q3 scores at the sixth grade level and 71 percent of the variance in SLA median percentile scores at the 4th-grade level.

Sub-sample of Predominantly-Black Schools

To determine how much achievement variance could be accounted for among predominantly-black schools in our sample--and hence the minimum amount rather clearly separable from race--a separate analysis using the same census variables was conducted with 46 schools which were 90 to 100 percent black in student body composition. The results are shown in Table 3.

The three census variables and two interaction terms accounted for approximately forty to sixty-five percent of the variance in reading achievement, depending on the year and test. No clear patterns are found in the percentages of variance predicted from one year to the next, thus indicating that relationships between community data and school achievement in Chicago may be more stable in predominantly-black neighborhoods than in racially-mixed and/or predominantly-white neighborhoods. This difference may be due to a tendency for aggregate change in residential patterns and/or school populations to occur more rapidly in the latter neighborhoods than in neighborhoods which already have become predominantly-black.

It should be noted that the smaller size of the predominantly-black sample tends to increase the percentage of variance accounted for (due to exploitation of error) as compared with the full sample of 114 schools, but the relatively restricted range of scores on the predictor (census) and criterion (achievement) variables among the former as compared with the latter tended to reduce the variance accounted for. Thus it is difficult to estimate how much variance might have been accounted for had our sample of predominantly-black schools been as large as the full sample.

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TABLE 3

Per Cent of Variance in Reading Achievement Accounted for by Three Selected Third Count Census Variables and Two Interaction Terms (46 Schools)+

	Year		
Reading Achievement Score	1968-1969	1970-1971	1971-1972
Q2, 4th Grade	42	42	35
Q2, 6th Grade	52	51	56
Q3, 6th Grade	57	58	63
Readiness for first grade	50	40	40

+The percentages are the squares of the multiple correlations corrected for sample size. The regression analyses reported in this table used forced-order equations with the independent variables entered in the following order: Per Cent of Females Separated, Per Cent of Occupied Units with 6 Persons or More, Per Cent Owner Occupied of Total Occupied Units, Per Cent of Females Separated x Per Cent of Occupied Units with 6 Persons or More, and Per Cent of Females Separated x Per Cent Owner Occupied Units with 6 Persons or More.

In general, the percentage of variance accounted for by a group of census variables was fifteen to twenty-five percentage points lower in the black sample than in the sample as a whole. This pattern raises the possibility that census variables may not be as powerful in predicting achievement levels in black schools as in predominantly-white schools in Chicago. Unfortunately, there were not enough schools in our sample with 90 per cent or more white students to test this possibility directly with a sub-sample of white schools. Lacking a comparable sub-sample of white schools, we cannot assume that census variables (and the underlying social forces they represent) are less important predictors of achievement in black neighborhoods in Chicago than in white schools or in schools throughout the city as a whole.

One possibly important difference between the two samples (i.e. 46 and 114 schools) was that the variable Per Cent of Females Separated was the best single predictor of achievement and had the highest regression coefficient in most runs with the total sample but generally was much less correlated with achievement and had insignificant coefficients in runs with the predominantly-black sample. The substantive meaning of this finding is somewhat speculative, but empirically it indicates that this measure of social disorganization is somewhat redundant in predicting achievement in black neighborhoods in Chicago. To explore this

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pattern further, we examined the regression equations and found that Per Cent of Females Separated generally had a high negative coefficient in the sub-sample of predominantly-black schools until the variable Per Cent Owner Occupied of Total Occupied Units was entered in the equations. This finding reflects the high redundancy ($r = -.87$) between the two variables in the sub-sample. In black neighborhoods with a high percentage of owner-occupied units, there are relatively low percentages of separated females and achievement is relatively high. In black neighborhoods with a high percentage of renters, there are high percentages of separated females and achievement is low. Consequently, the percentage of separated females does not add as much in predicting achievement as is true in the sample as a whole, for which the zero-order correlation is only .66.

The fact that Per Cent of Females Separated has a significant coefficient in equations for the total sample but not for the black subsample indicates that for the sample as a whole its relationship with achievement probably reflects its association with race and, possibly, other variables correlated with poverty and socioeconomically disadvantaged status in Chicago.

The high degree of intercorrelation which exists between renter-occupied units and separated females in our sub-sample of black schools leads us to suspect that the relatively low achievement level in black neighborhoods with high percentages of renters may be reflecting patterns of social disorganization which in turn may be characteristic of low-status neighborhoods with many families headed by females and little home ownership. The data do not allow us to test this proposition or to determine whether the high incidence of separated females in these neighborhoods may be contributing to or reflecting social disorganization, or some combination of the two. Nor are we able to say whether families with separated females in ghetto neighborhoods with high percentages of renter occupancy may produce children lower in achievement than intact families in these neighborhoods or whether heavily-rental ghetto neighborhoods with many separated females produce relatively low-achieving children regardless of the type of family.

Our data definitely do indicate, however, that density of population is associated with low achievement in predominantly-black schools in Chicago. The census variable with the most significant regression coefficient which we identified for purposes of predicting school achievement scores in the black sub-sample was Per Cent of Units with 6 Persons or More. This finding supports the conclusion that ghetto neighborhoods with high density of population as measured by persons per dwelling unit have lower-achieving children than ghetto neighborhoods with fewer persons per dwelling unit. Whether density has an effect over and beyond its association with socioeconomic level cannot be determined here since we have no usable direct measures of income and occupation from the Third Count data.

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II. FOURTH COUNT ANALYSIS

One major advantage in using fourth count data on census tracts rather than third count data on blocks when studying relationships between community characteristics and school achievement is that tracts do not require as much laborious collation of information on very small units. If tract data "predict" or "explain" school outputs as well or almost as well as block data, the work involved in collecting information on communities or neighborhoods lying within school attendance boundaries can be done much more simply and cheaply.

In addition, the fourth count of the Census contains information on many more types of variables, including several such important sociological measures as occupation and education; thus fourth count data potentially may be even more valuable than third count data in accounting for school outputs or other social systems outcomes. For these reasons, we conducted a series of analyses to help determine the usefulness of fourth count data in predicting achievement scores and identifying socioeconomic and demographic correlates of achievement in our sample of 114 schools and our sub-sample of 46 predominantly-black Chicago elementary schools.

As in our third count study, we began by collating census data with school attendance boundaries, i.e. by identifying the census tracts or portions of census tracts within each school's attendance area. Since tracts are considerably larger than blocks and are not coterminous with attendance areas, we faced a problem not encountered in collating blocks with attendance areas--that of deciding where to place a tract that overlapped two or more attendance areas. Inspection of school district and government census maps does not allow one to determine whether most of the population lives in one or another part of a geographic unit; therefore it is not possible to be perfectly accurate in assigning part of one tract to one school and part to another. Our response to this problem was to work only with tracts which lay entirely or almost entirely within one attendance area.

Fourth count variables selected for inclusion as independent variables in this study are shown in Table 4. In many cases these variables were taken directly from the Census, i.e. were extracted exactly in accordance with Bureau of the Census definitions and reports.[8] In a number of cases, however, we constructed our own variables from data reported in various parts of the fourth count when we felt that

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[8] Definitions of fourth count variables included in the 1970 Census can be found in: "Fourth Count Summary Tapes from the 1970 Census of Population and Housing," Data Access Description No. 22. U. S. Department of Commerce Bureau of the Census, March 1971. Many of the data on these variables are reported in 1970 Census of Population and Housing. Census Tracts. Chicago, Ill. SMSA PHC (1)-43. Washington, D. C.: U. S. Department of Commerce Bureau of the Census, May 1972, but some are reported only on computer tapes and are not included in Census Bureau publications.

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TABLE 4

Forty-Four Fourth Count Variables Intially Examined in Relation to School Achievement+

Variable Number	Abbreviation	Title
* 1	Adults Worked 40+ Weeks - 1969	Per Cent 25-64 Worked 40 or More Weeks in 1969
* 2	Below Low-Income Level	Per Cent Families Below Low-Income Level
* 3	Children in Families Below $3000	Average Number of Children 5-17 Years of Age in Families Below $3000
4	Children in Female-Head Families Below Poverty Level	Per Cent Children in Female Head Families Below Poverty Level
5	Children Living with 1 Parent	Per Cent Children Under 18 Years of Age Living with 1 Parent
* 6	Craftsmen and Operatives, Male	Per Cent Males Craftsmen & Operatives
7	Different House	Per Cent Population in Different House in Same City 1965
* 8	Families Below $5000	Per Cent Families with Income Under 5000
* 9	Families Below Poverty Level	Per Cent Families Below Poverty Level
10	Female Head Families	Per Cent Families with Female Head
*11	Female Head Families in Poverty	Per Cent Families with Female Heads and Below Poverty Level
12	Female Head Families in Poverty with Young Children	Per Cent Female Head Families Below Poverty With Children Under Six
*13	Females Less than 9 Yrs. School	Per Cent Females 25 and Over with Less than 9 Yrs. School
*14	Female 16-21 Unemployed	Per Cent Females 16-21 Unemployed
15	Female Unemployed	Per Cent Unemployed Females
*16	High School Graduates - Female	Per Cent High School Graduates Among Females 15-44
*17	High School Graduates - Male	Per Cent High School Graduates Among Males 20-49
*18	Income Deficit Below Poverty	Average Income Deficit Among Families Below Poverty**
19	Income, Female Head Families	Average Dollar Income, Families with Female Head
*20	Laborers and Service, Female	Per Cent Females Laborers, Service Workers

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TABLE 4 (Cont'd.)

Variable Number	Abbreviation	Title
*21	Laborers and Service, Males	Per Cent Males Laborers and Service Workers
*22	Less than Half Low-Income Level	Per Cent Families Less Than Half Low-Income Level
23	Less than 3 Yrs. College, with Voc. Trng.	Per Cent 16-64 with Less Than 3 Years College and With Voc. Training
24	Males in Institutions	Per Cent Males 16-65 in Institutions
*25	Males Less than 9 Yrs. School	Per Cent Males 25 and Over with Less Than 9 Yrs. School
*26	Males not in Labor Force	Per Cent Male Heads Unemployed and Not in Labor Force
27	Males 16-21 Unemployed	Per Cent Males 16-21 Unemployed
28	Male Unemployed	Per Cent Unemployed Males
29	Moved from South	Per Cent Population in South 1965
*30	Moved Since 1967	Per Cent Moved to Present Quarters Since 1967
31	Native South	Per Cent Natives Born in South
32	Not in Labor Force	Per Cent Not Disabled and Not in Labor Force
33	Number of Children, Female Head Families	Average Number of Children in Subfamilies with Female Heads
*34	Population Under 18	Per Cent Population Under 18 Years of Age
*35	Professionals and Managers, Males	Per Cent Males Professionals and Managers
36	Public Assistance	Per Cent Families Receiving Public Assistance
37	Public Assistance Families in Poverty	Per Cent Families Below Poverty Level and Receiving Public Assistance
*38	Residences Built Before 1940	Per Cent Residential Structures Built Before 1940
*39	Residences with 5 or More Units	Per Cent Residential Structures with 5 or More Units
*40	Three Times Above Low-Income Level	Per Cent Families Three Times or More Above Low-Income Level
*41	Units with 1.51+ People Per Room	Per Cent Persons in Units with 1.51 or More People Per Room
42	Unrelated Individuals	Per Cent Unrelated Individuals
43	Use Mass Transit	Per Cent Use Mass Transportation For Work
*44	Youth Worked 40+ Weeks - 1969	Per Cent 16-24 Worked 40 or More Weeks in 1969

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TABLE 4 (Cont'd.)

+Unless otherwise specified, numbers in the variable titles refer to ages or age ranges.

*Variables constructed for the study from U. S. Census Bureau data.

**The income deficit is the difference between the total income of families below the low-income level in a census enumeration unit and their respective low-income thresholds.

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community characteristics identified in this way might be particularly appropriate to study in relation to school achievement. One example of such a variable is Per Cent of Families Below Poverty Level. Both types of variables are shown in Table 4. Altogether, there were forty-four census variables included in our initial analysis.

The first step in the study was to obtain a correlation matrix showing the relationships between and among the 44 census variables and several selected school achievement measures. Based on inspection of the matrix as well as data on the means and distributions of the census variables, we reduced the set of 44 variables to 17 which we retained for use in more detailed and comprehensive analysis.[9] Reasons for elimination of variables included one or more of the following: too narrow a spread in scores (by school) which might either reduce the discriminating power of a variable or make it too unstable; obvious redundancy with one or more other variables which had a more satisfactory distribution across the sample; and lack of any zero-order relationship with school achievement. The 17 variables which were included at this point in the analysis are shown in Table 5.

The next step in the analysis was to regress the seventeen census variables against twelve selected school achievement measures in order to obtain data on the regression coefficients, standard errors, and multiple correlations. Examination of these data showed that a reduced set of eleven variables (Table 6) resulted in a loss of variance accounted for greater than two percentage points in only one of the twelve cases. This does not seem too high a cost in prediction to pay for the reduction of six variables, in view of the savings in time and expense and the greater stability likely to be gained by a reduction of this magnitude.

For analyses in the sub-sample of 46 predominantly-black schools, however, the variance lost is much greater, exceeding six percentage points in six of the twelve comparisons. This pattern indicates that the six variables removed from the seventeen-variable set may be more salient and important in predicting achievement among the sub-sample than in the sample as a whole. We attempted to compensate for some of this reduction in subsequent analyses reported in the remaining parts of this chapter.

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[9] Data on the 114-school total sample and the 46-school sub-sample of predominantly-black shools (see previous chapter) were inspected separately.

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TABLE 5

Seventeen Fourth Count Variables Selected for Additional Analysis in Relation to School Achievement+

Variable	Mean	Standard Deviation	Kurtosis	Skewness
1. Female Head Families	20.20	11.77	1.75	1.41
2. Moved Since 1967	39.19	12.52	0.28	0.29
3. Female 16-21 Unemployed	46.14	18.51	-0.56	-0.33
4. Females Less than 9 Yrs. School	36.80	11.10	0.31	0.18
5. Less than 3 Yrs. College with Voc. Trng.	24.70	6.07	0.26	0.09
6. High School Graduates - Male	24.27	17.22	1.48	1.32
7. High School Graduates - Female	17.62	14.12	6.09	2.07
8. Male Unemployed	4.08	3.09	30.05	4.69
9. Professionals and Managers, Male	13.72	10.36	2.96	1.70
10. Craftsmen and Operatives, Male	34.65	8.69	0.07	0.41
11. Income Deficit Below Poverty	16.55	3.72	3.52	-1.03
12. Three Times Above Low-Income Level	44.51	20.19	-0.79	-0.00
13. Males Not in Labor Force	2.98	3.23	9.46	2.46
14. Income, Female Head Families	7079.05	2416.43	.01	.23
15. Residences with 5 or More Units	35.68	26.93	-.69	.72
16. Residences Built Before 1940	63.88	25.48	-.05	-.96
17. Units with 1.51+ People Per Room	3.61	3.28	.68	1.24

+The full titles and definitions for these variables are shown in Table 4.

Since we felt that the set of eleven census variables still might be too large to work with easily in studying relationships with achievement in future research on a large number of school districts, we again inspected the regression data to determine whether still more census variables might be eliminated without substantial loss in capability to account for variance in achievement among schools in the total sample and the sub-sample. Based on theoretical considerations as well as examination of scattergrams, this exploration included an examination of

TABLE 6

Squared Multiple Correlations (R^2) Between Sets of Selected Fourth Count Variables and Twelve School Achievement Measures*

Achievement Measures, Total Sample (114 Schools)

Number of Variables	Q2 4th grade			Q2 6th grade			Q3 6th grade			Readiness for first grade		
	1968-69	1969-70	1971-72	1968-69	1969-70	1971-72	1968-69	1969-70	1971-72	1968-69	1969-70	1971-72
17	.72	.73	.64	.76	.79	.78	.76	.81	.79	.68	.73	.75
11	.70	.71	.64	.76	.79	.78	.76	.81	.79	.68	.72	.66
8	.74	.75	.69	.78	.82	.81	.75	.79	.80	.72	.72	.66
4	.74	.75	.69	.77	.80	.80	.76	.78	.79	.72	.72	.66
2	.74	.74	.69	.76	.80	.80	.75	.77	.79	.70	.66	.61

Achievement Measures, Sub-sample of Predominantly-Black Schools (46 Schools)

Number of Variables	Q2 4th grade			Q2 6th grade			Q3 6th grade			Readiness for first grade		
	1968-69	1969-70	1971-71	1968-69	1969-70	1971-72	1968-69	1969-70	1971-72	1968-69	1969-70	1971-72
17	.61	.46	.55	.59	.51	.51	.56	.52	.52	.51	.51	.54
11	.51	.42	.41	.63	.48	.60	.61	.56	.58	.55	.49	.46
8	.53	.44	.38	.60	.47	.63	.58	.57	.61	.56	.45	.53
4	.52	.44	.37	.59	.48	.66	.58	.57	.61	.56	.45	.53
2	.47	.44	.35	.57	.46	.56	.51	.50	.54	.54	.45	.48

*The correlations have been corrected for sample size.

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transformed terms (e.g. logged variables, squared variables, interaction terms) which resulted in the selection of the eight "best" predictor census terms shown in Table 7. Multiple correlations from forced-order equations using these variables and the twelve achievement measures are shown in Table 6.

TABLE 7

Eight Fourth Count Variables Selected for Additional Analysis in Relation to Achievement+

1. Units with 1.5 People per Room (logged)
2. Three Times Above Low-income Level (squared)
3. Males Not in Labor Force (square root)
4. Moved Since 1967
5. High School Graduates, Females
6. Professionals and Managers, Males (square root)
7. Females 16-21 Unemployed
8. Female Head Families

+The full titles and definitions for these variables are shown in Table 4. Variables were entered in the order shown above for the full sample. The order of variables used with the 46 school sub-sample was slightly different. In most cases, signs for these variables were in expected directions, e.g. negative relationship between People per Room and achievement.

For the total sample, little or nothing is lost by reducing the variable set from eleven to eight in any of the twelve comparisons, and in seven cases the percentage is increased because the transformed variables are picking up more variance than the original variables. The only pattern discernible with respect to grade level is that the census variables appear to be slightly more powerful in explaining achievement at the sixth-grade level, where the R^2s tend to be in the high 70's, than at the fourth- or first-grade levels. This pattern may reflect differences in test characteristics at various levels or other possible causes such as a strengthening of neighborhood influences on achievement when students enter the upper grades.

For the sub-sample, several percentage points are lost in four cases by reducing the set of variables from eleven to eight, but the transformed variables generally have kept this loss from being very large and in seven cases the percentage of variance accounted for has been increased.

At this point it should be noted that the eight remaining "best set" census variables represent distinctly different types of socioeconomic-demographic information. One (High School Graduates, Female) is an education variable, one (Units with 1.51+ People Per Room) is a density

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variable, one (Moved Since 1967) is a mobility variable, two (Female 16-21 Unemployed) and (Males Not in Labor Force) are employment variables, one (Professionals and Managers, Males) is an occupation variable, one (Female Head Families) is a family structure variable, and the eighth (Three Times Above Low-Income Level) is an income variable. (Our final third-count variables, described in the preceding section, also tapped three distinctly different types of information.) This finding suggests that major components of urban social structure make independent contributions in explaining achievement differentials in a big city school district. It also suggests that the effects of various kinds of socioeconomic disadvantage are additive, i.e. that being poor and living in crowded housing and having parents with relatively low levels of education, etc., is more detrimental in terms of educational achievement than are the isolated effects of disadvantagement on only one or a few dimensions of social status.*

The next step in our analysis was to further reduce the set of eight variables to determine how much variance in achievement could be explained by a smaller number. As shown in Table 6, four variables continued to account for sixty-six to eighty percent of the variance in the full sample and thirty-seven to sixty-one percent of the variance in the sub-sample of predominantly-black schools. These four variables were the following:

1. Units with 1.51 People Per Room (logged).
2. Three Times Above Low-Income Level (squared).
3. Moved Since 1967
4. Males Not in Labor Force (square root).

For the 46 school sub-sample, the four best predictors were:

1. Units with 1.51 People Per Room (logged).
2. Moved Since 1967.
3. Males Not in Labor Force (square root).
4. High School Graduates, Females.

Following this reduction the best two predictor variables were selected from among the reduced set of four. As shown in Table 6, the best two variables accounted for sixty-one to eighty percent of the variance for the full sample and thirty-five to fifty-seven percent of the variance for the sub-sample. The two variables for the full sample were Units with 1.51 People Per Room (logged) and Three Times Above Low-Income Level (squared). The two variables for the sub-sample were Units with 1.51 People Per Room (logged) and Moved Since 1967. These results demonstrate that a limited number of census tract variables can account for a substantial proportion of the achievement variance in grade-level reading scores among elementary schools in Chicago.

*In equations with some dependent (achievement) variables, four or five of the eight predictors had statistically significant regression coefficients, while in others only two or three were significant. An example of the former is given in Appendix A1 and an example of the latter in Appendix A2. Nearly all statistically significant coefficients were in the expected directions (high poverty or disorganization and low status = low achievement).

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Factor Analysis

Because it may be of some interest to compare our census data on Chicago with those of several other researchers who have conducted census-data studies in U. S. cities, we carried out a factor analysis of the seventeen census variables selected as promising predictors of elementary school achievement levels in Chicago (Table 5).

Using the standard principal-factors solution with varimax rotation in the Statistical Package for the Social Sciences, four factors with eigenvalues of 1 or more were identified, accounting for 81 percent of the variance among the seventeen variables.[10] However, three of the variables did not load as high as .4 on any factor which included at least one other variable loading at least this high;[11] for this reason the three variables were eliminated from the set and another principal-factor analysis with varimax rotation was carried out in order to clarify the structure of relationships among the remaining fourteen variables.

Three principal factors were identified, accounting for 81 percent of the variance among the fourteen variables. Using the .40 criterion for including a variable as a constituent of a factor, each of the variables loaded on at least one factor, and only one (Professionals and Managers, Male) loaded on more than one factor. The variables loading on each of the three factors are shown in Table 8.

As shown in Table 8, the highest loading variable on Principal Factor I was Female Head Families. Other variables loading on the factor denoted poverty, density, unemployment, and occupation. This factor was named Inner City Poverty.

The highest loading variable on Principal Factor II was High School Graduates, Female. Other variables loading on the factor denoted additional measures of education as well as occupation. This factor was named Occupational - Educational Status.

The two variables which loaded on Principal Factor III were Moved Since 1967 and Residence Built Before 1940. This factor was named Old Neighborhoods with High Mobility. In Chicago, this type of neighborhood tends

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[10] The principal-factors solution (commonalities in the diagonals) was used because it does not assume, as does the principal components solution, that the data set is error free. (See Richard L. Gorsuch, Factor Analysis. Philadelphia: W. B. Saunders Co., 1973.) A varimax rotation was used because it is the type of rotation which has been reported most frequently by researchers dealing with census data on cities.

[11] As recommended by Gorsuch (Ibid.), a loading of .4 is roughly comparable to a statistically significant correlation at the .05 level between a factor and a component variable in a sample of 100 cases. In the absence of other criteria for selecting loading levels in reporting factors, this level was chosen to help determine the constitution and titles of the factors.

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Loadings of Fourteen Selected Census Variables on Three Principal Varimax Factors (114 Schools)

	Variable	Factor I	Factor II	Factor III
1.	Female Head Families	.93	-	-
2.	Three Times Above Low-Income Level	-.86	-	-
3.	Units with 1.51+ People Per Room	.86	-	-
4.	Male Unemployed	.75	-	-
5.	Female 16-21 Unemployed	.74	-	-
6.	Income, Female Head Families	-.73	-	-
7.	Residences with 5 or More Units	.62	-	-
8.	Professionals and Managers, Male	-.53	.78	-
9.	High School Graduates, Female	-	.86	-
10.	Craftsmen and Operatives, Male	-	-.84	-
11.	High School Graduates, Male	-	.76	-
12.	Females Less than 9 Yrs. School	-	-.64	-
13.	Moved Since 1967	-	-	.82
14.	Residence Built Before 1940	-	-	.79

to be largely renter rather than owner occupied, as was demonstrated by a supplementary factor analysis in which we added Per Cent of Residential Units Owner Occupied as an additional variable and obtained a loading of -.67 on Factor III. Therefore this factor might have been labeled Old, Rental Neighborhoods with High Mobility.

Using 1960 census-tract data on 57 variables, Rees[12] carried out a varimax factor analysis for the City of Chicago and identified three distinct factors: Race and Resources; Socioeconomic Status; and Stage in the Life Cycle. These factors differ from those found in our study partly because of differences in the census year and the number of tracts included in the analysis but mainly because the types of variables included in the analysis were quite different. For example, we did not include variables on race and so could not obtain a factor exactly similar to Rees' Race and Resources.

Nevertheless, the results are strikingly similar in that in both studies the first factor denotes poverty-related variables and their correlates

[12] Philip H. Rees, "Concepts of Social Space: Toward an Urban Social Geography," in Brian J. L. Berry and Frank E. Horton, Geographic Perspectives on Urban Systems. Englewood Cliffs, New Jersey: Prentice-Hall, 1970, pp. 306-394.

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(e.g. race,[13] high-density housing), while the second factor separates out variables dealing with two other major components of social status; education and occupation. In Chicago, it is clear, race-related differences in economic resources on the one hand and education-occupation characteristics on the other constitute factorially separate components in the underlying social structure of the city.[14]

Utilizing 1950 data on Toledo census tracts, Anderson and Bean[15] carried out a varimax factor analysis and identified four factors in which the highest loadings respectively included: 1) multifamily dwelling units, females in the labor force, percent married, median family income and several other variables; 2) fertility ratio, double occupancy; 3) occupation, education; and 4) percent Negro. These results are similar to ours in that an inner-city poverty or resources factor emerges clearly separate from education-occupation, thus suggesting that the pattern may be widespread in cities much smaller than Chicago. The results differ in that percent Negro in Toledo emerged clearly separate from the poverty-resources factor, which (as Anderson and Bean point out) replicated findings in at least ten other cities[16] showing that per cent Negro or other indices of segregation constituted a separate factor in orthogonal solutions. While this discrepancy may arise because race and resources are particularly confounded in Chicago as compared with other cities in the

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[13] While we did not include a variable measuring per cent black in our fourth-count analysis, we did correlate per cent black in school enrollment with our fourth-count variables and obtained correlations as high as .69 with per cent female-headed families, -.62 with per cent triple low-income level, and .60 with persons per room. These correlations suggest that per cent black would load on our Factor I.

[14] Hadden and Borgatta's well-known varimax factor analysis (J. Hadden and E. F. Borgatta, American Cities. Their Social Characteristics. Chicago: Rand-McNally, 1965.) indicated that income-education-occupation constituted one factor (i.e. Socioeconomic Status) while race and family disorganization constituted a separate factor among census tracts in all U. S. cities analyzed by region. While this pattern may be true of many cities in the U. S., our review of the literature indicates that it does not emerge in many others, particularly when individual cities are the units of analysis (see studies cited elsewhere in this section). More specifically, data on larger and older cities indicate that race and ethnicity are so closely associated with economic components of status that they form a single factor (e.g. Rees, op. cit.).

[15] Theodore R. Anderson and Lee L. Bean, "The Shevky-Bell Social Areas: Confirmation of Results and a Reinterpretation," Social Forces, , 119-124.

[16] See Maurice D. Van Arsdol, Jr., Santo F. Camilleri, and Calvin F. Schmid, "An Application of the Shevky Social Area Indexes to a Model of Urban Society," Social Forces, 37 (1958), 26-32.

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U. S.,[17] it may also be due either to differences in data-collection time and methods or to evolutionary trends which became discernible in Chicago and other cities in the 1960's. In particular, it is possible that while race and resources were intertwined by 1960 in Chicago and other older, large cities, such a trend now may be becoming more national and/or regional in scope.

Finally, one may note Sweetser's study of metropolitan Boston in which varimax factor analysis was utilized with 1960 census-tract data and it was found that median family income correlated highly with education and occupation variables in the outer part but not the inner core of the metropolitan area.[18] This finding suggests that income may be closely tied to education and occupation in the suburban ring as well as the metropolitan area as a whole, but that economic resources in the inner core sections of large, old cities such as Boston and Chicago may have become tied particularly closely to race and ethnicity, housing deterioration, high population density, family disorganization, and other types of "inner city" variables. (Sweetser did not obtain a high loading for "nonwhite" on his income factor, but Boston may be a poor test since the percentage black is relatively small.) Some implications of this type of concentration in big-city poverty are discussed in the following chapter in the section on "Concentrated Urban Poverty."

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[17] Such a pattern is in line with Tropman's re-analysis of Hadden and Borgatta's 1960 census data. Tropman's study suggested that while income was related to race (percentage non-white) in both large and small cities, it was not as closely related to "maturity" in smaller as in larger cities. Tropman concluded that the relationship between income and race seemed to be related both to size and age of the cities in his sample. John E. Tropman, "Critical Dimensions of Community Structure," Urban Affairs Quarterly, v. 5, no. 2 (1969), 215-232.

[18] Frank L. Sweetser, "Ecological Factors in Metropolitan Zones and Sectors," in Dogan Mattei and Rokkan Stein, eds., Quantitative Ecological Analysis in the Social Sciences, Cambridge, Massachusetts: MIT Press, (19 , pp. 413-456.

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III. COMPARISON WITH OTHER RESEARCH

The purpose of this chapter is to compare our results with those of other researchers who have used socioeconomic data to account for variance in school achievement, using school- or district-level data rather than individual student scores as the unit of analysis.

The review of studies in this section is highly selective. We have not tried to include all the research in which socioeconomic data or census data have been utilized for the purpose of explaining school achievement. The studies cited are included because of their special relevance as regards empirical findings and theoretical issues in the present study.

As noted above, our original interest in examining relationships between socioeconomic data and school achievement was stimulated by a 1969 study in which Garms and Smith derived equations accounting for 70 to 71 percent of the achievement variance among a sample of 45 schools in the State of New York.[19] Achievement data consisted of a combination measure for reading and math and were based on a sample of fourth-grade students from the participating schools. Socioeconomic (predictor) variables included racial and ethnic background, broken homes, welfare, parental education, overcrowded housing, and mobility.

In a subsequent study conducted for the Fleischmann Commission in New York State, Garms and his colleagues collected data on random samples of 20 third-grade students in 301 schools and found that just three socioeconomic variables, together with their interaction terms, predicted almost 62 percent of the variance in a composite achievement variable denoting the percentage of students below minimal levels in reading and math.[20] The three socioeconomic variables measured percent from broken homes, percent living in overcrowded housing, and mother's education. These data were collected by means of questionnaires filled out by the parents of students in the sample. A separate analysis of 65 New York City elementary schools (within the larger state sample of 301 schools) showed that the three socioeconomic variables and their interaction terms accounted for 67 percent of the variance in the composite achievement measure.

Douglas J. McRae examined the relationship between socioeconomic and other student background data on the one hand and school achievement data on the other among a nationwide stratified random sample of approximately 200,000

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[19] Walter I. Garms and Mark C. Smith, "Educational Need and Its Application to State School Finance," op. cit., 304-317.

[20] Walter I. Garms, "An Approach to the Measurement of Educational Need." New York: Teachers College, Columbia University, August, 1971.

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students included in standardization studies for the Short Form Test of Academic Aptitude.[21] The achievement variables in the study utilized grade-level mean scores on the California Achievement Tests. Socioeconomic data on students were collected by means of a questionnaire sent to the principals of participating schools. Following a series of analyses designed to reduce seventy-two socioeconomic and other student background variables (e.g. ability scores) to a more manageable number, McRae found that sets of six socioeconomic variables exclusive of race accounted for 85 percent of the variance in reading scores at the tenth grade level, 74 percent at the sixth grade level, 73 percent at the fourth grade level, 76 percent at the third grade level, and 59 percent at the first grade level.[22]

McRae did not utilize a single set of six predictor variables in obtaining these multiple correlations but instead chose the most potent predictors from stepwise regression equations including 26 variables for each grade level and type of achievement score; hence his correlations are for equations with differing sets of socioeconomic variables and are somewhat difficult to compare with our own. McRae does report, however, that the most "frequently selected" socioeconomic variables included percent of students whose fathers are unskilled, percent whose fathers are professionals, and percent of students in homes with only one parent.[23] While McRae obtained multiple correlations in about the same range as those reported in the present study (see above), it is impossible to tell whether any single set of predictor variables similar to ours would have accounted for nearly as much variance (i.e. 70-80 percent) in his sample of approximately 400 schools.

As part of a study of 130 Atlanta elementary schools conducted for the Urban Institute by White, et al., data on the number of students receiving free and reduced-price lunches were utilized to account for the variance in reading and in mathematics scores for grades one through seven.[24] The authors corrected irregular information and then used

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[21] Douglas J. McRae, "The Relationship of Aptitude Test School Means and School Socioeconomic Characteristics to Achievement Test School Means." Texas Christian University, Institute of Behavioral Research Report #73-1, February 1973.

[22] These figures are examples of squared multiple correlations obtained with regression equations utilizing 26 socioeconomic variables run to six iterations for twelve achievement measures at each of twelve grade levels. Overall, the median squared multiple correlations for the six predictor sets were in the low to middle 70's. See McRae, Ibid., p. 20.

[23] Ibid., p. 21.

[24] Bayla F. White, et al., "The Atlanta Project: Developing Signals of Relative School Performance." Washington, D. C.: The Urban Institute.

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attendance data to derive rates for participation in the subsidized lunch program in order to predict achievement differentials among schools for the academic year in which participation rates were constructed. After pointing out that "Since participation . . . is determined directly by family size and income, . . . /the rate/ is a surrogate for the economic characteristics of the students at each school," they reported that the participation variable (i.e. participation in the subsidized lunch program) "accounts for 50 to 80 percent of the variation of average scores in each grade level across all schools in the city."[25] This result appears to approximate our own findings using a sample roughly similar in size, but White, et al. do not indicate whether the majority of their equations yielded squared multiple correlations falling toward the lower or higher side of the "50 to 80 percent" range cited in their monograph.

Recent studies carried out for the International Association for the Evaluation of Educational Achievement (IEA) have reported cross-national data relating students' social background to achievement in a variety of fields in the U. S. and a number of other countries. Data on student socioeconomic background were obtained through student questionnaires and included criterion-referenced information on father's occupation. Adding student-reported information on number of books in the home, use of dictionary in the home, and number of siblings, a "School Handicap Score" was prepared for each participating school. Utilizing school-level achievement means for tenth graders on a specially-constructed test of reading comprehension, IEA researchers were able to account for eighty percent of the achievement variance among schools in the U. S. sample.[26] Although these results are not strictly comparable to our own inasmuch as only one of the four variables in the School Handicap Score is a socioeconomic variable (i.e. father's occupation), it is pertinent to note that the IEA student-reported measures of home environment together with father's occupation accounted for about as much of the variance in reading achievement as did the best equations in our own as well as other studies cited on the preceding pages.

Re-analyses of the widely-known study on Equality of Educational Opportunity by Coleman, et al.[27] also provide information on the relationships between the socioeconomic background of students and grade-level achievement scores in U. S. schools. One of the major follow-up

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[25] Ibid., p. 17.

[26] Robert L. Thorndike, Reading Comprehension Education in Fifteen Countries. New York: Wiley and Sons, 1973, p. 111.

[27] James S. Coleman, et al., Equality of Educational Opportunity. Washington, D. C.: U. S. Government Printing Office, 1966.

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studies using these data was carried out by Mayeske, et al. and found that socioeconomic background accounted for 53 percent of the variance in verbal achievement at the third-grade level (2,453 schools) and 79 percent at the sixth grade (2,372 schools).[28] Socioeconomic data were collected by means of student questionnaires. Variables loading highest on the Socio-Economic Status Index at the sixth-grade level and their respective Index weights were as follows: Father's Educational Level - 78; Mother's Educational Level - 75; Father's Occupational Level - 61; Number of Siblings - 44; Reading Materials in the Home - 43; and Appliances in the Home - 42.[29] Thus, as in the case of the IEA study, parental occupation (and education) together with selected home environment measures accounted for about 80 percent of the variance in achievement with a sample of students from the upper elementary grades.

As part of a 1973 Rand Corporation study designed to identify unusually effective schools, Klitgaard and Hall utilized State of Michigan Assessment data on school achievement and school socioeconomic characteristics.[30] The Socio-Economic Status Index for Michigan schools is based on questionnaires administered to students and includes items measuring parental education, stability of the home, family travel, consumer goods in the home, and student aspirations for education. Using regression equations for samples of non-rural schools and including Socio-Economic Status, minority enrollment, and community type (e.g. metropolitan core; urban fringe) as predictor variables (N's ranged from 380 to 1891), Klitgaard and Hall examined fourth and seventh-grade achievement scores and obtained squared multiple correlations ranging from .59 to .78 for reading and math achievement.[31] It is interesting to note that these correlations are in approximately the same range as our own (see above) even though data on minority enrollment were included in the set of predictor variables.

Hogan used census information on 213 school systems (i.e. school-district level data) and their "associated communities" to examine the relationships between 23 socioeconomic variables and achievement on the Stanford Achievement Test (grades 4-8) and the Metropolitan Achievement Test (grades 2-8).[32] His review of previous research suggested "that a multiple R of .70 can be taken as a good representation of how closely an optimum combination of several community variables correlates with the average intelligence level of children in the community."[33] Hogan's own study, which he described as

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[28] George W. Mayeske, et al., A Study of Our Nation's Schools. Washington, D. C.: U. S. Government Printing Office, 1972, p. 71.

[29] Ibid., p. 13.

[30] Robert E. Klitgaard and GeorgeR. Hall, A Statistical Search for Unusually Effective Schools. Santa Monica, California: Rand Corporation, 1973.

[31] Ibid., p. 46.

[32] Thomas P. Hogan, Socioeconomic Community Variables as Predictors of Cognitive Test Performance of School Children. Ph.D. Dissertation, Fordham University, 1970.

[33] Ibid., p. 13.

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"the largest source of data ever used in such an investigation in terms of number of students, number of school systems, and number of grades,"[34] showed that squared multiple correlations between achievement and "a maximum of five socioeconomic variables typically approached" a value of .85 for school systems which served coterminous census units. He also reported that the "best socioeconomic predictors of test performance were relatively direct measures of amount of schooling and income for adults in the communities."[35]

In general, this review of previous studies dealing with the "prediction" or "explanation" of school achievement from socioeconomic census data suggests that the 1970 census variables we utilized in characterizing neighborhoods serving elementary schools in Chicago constitute a useful set in accounting for achievement differences among these schools--the proportion of variance in achievement we were able to account for using only a few predictors tends to be at least as high and usually a little higher than has been true in roughly comparable previous studies. In the light of this finding, the fact that both our third and fourth-count variables delineate several major components of social status each of which may contribute independently to the prediction of achievement in a big city suggests that individuals residing in neighborhoods consistently low on multiple measures of status (i.e. concentrated poverty neighborhoods) may suffer severe educational and other social disadvantages over and beyond commonly-found linear relationships between low social status and social disadvantagement. This possibility is further explored in the following pages.

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[34] Ibid., p. 40.

[35] Ibid., p. 88.

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IV. DISCUSSION AND IMPLICATIONS REGARDING CONCENTRATED URBAN POVERTY

One of our original purposes in conducting this study was to determine whether evidence could be found of a differential effect on school achievement associated with concentrated urban poverty. That is, we sought to determine whether school achievement would be related to the geographic concentration of low-income population in our sample over and beyond direct relationships which frequently have been found to exist between school achievement (or other outputs of urban social systems) and poverty or poverty-related characteristics such as sub-standard housing.

The results of the study suggest that differences in achievement among the schools in our sample are associated with differentials in the concentration of poverty and poverty-related characteristics. Stated differently, whether poverty and its correlates are relatively concentrated (or absent) in the urban neighborhoods in our sample is related to the degree to which achievement scores in local schools are unexpectedly lower (or higher) than would be predicted on the basis of a linear relationship between poverty and achievement. Evidence to support this conclusion is presented in the following pages.

1. Interaction Terms in the Regression Equations

Our best third-count (Chapter I) equation included terms for Percent Owner Occupied Units X Percent of Females Separated and Percent of Units with 6 Persons or More X Per Cent of Females Separated. The fact that additional variance was explained by these terms suggests that achievement in neighborhoods which are relatively high or low on two or more poverty-related variables tends to be higher or lower than would be predicted on the basis of the additive relationship between achievement and the predictor variables considered separately. This type of finding suggests that relationships between census data and school achievement are not entirely linear: neighborhoods in which poverty is concentrated (or absent) in the sense that they are relatively impacted (or non-impacted) on at least two of its manifestations or correlates, serve schools in which achievement tends to be lower (or higher) than predicted on the basis of the separate relationships between the predictor (census) variables and achievement.

Again, this interpretation must be taken as tentative inasmuch as the interaction terms which added to the variance explained in our regression equations actually may be reflecting linear relationships between achievement and other social or demographic variables not included in the study. In addition, variance picked up by interaction terms possibly may reflect scaling characteristics of the predictor measures used in the study rather than real non-linear relationships between the predictor variables and the criterion variables.[36] Interactions sometimes are found to be statistically

[36] Richard S. Bogartz and John W. Wackwitz, "Transforming Response Measures to Remove Interactions or Other Sources of Variance," Psychonomic Science, v. 19, no. 2 (1970), 87-89; Paul Slovic and Sarah Lichtenstein, "Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgment," Organizational Behavior and Human Performance, v. 6 (1971), 649-744.

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significant primarily because they reflect a floor or a ceiling effect in the measurement of either or both of the predictor variables.

On the other hand the interactions we identified do make sense theoretically in explaining the output of urban social systems such as the public school. For example, it is reasonable to believe that students living in female-headed families in cramped quarters (i.e. 6 persons or more per unit) suffer disadvantages in socialization and education greater than any disadvantages associated with father-absent family patterns or overcrowded housing considered separately. Similarly, it is reasonable to expect that students in neighborhoods characterized by very low income and by a low percentage of persons in professional occupations may suffer disadvantages greater than those associated with these variables separately. For this reason we believe that the interaction terms in our equations indeed may be reflecting special educational disadvantages related to differentials in the concentration or dispersal of social-economic resources in urban neighborhoods.

2. Non-linear Terms in the Regression Equations

As shown in our analysis of the relationships between fourth-count census tract data and school achievement, our "best" (i.e. most explanatory) regression equations for predicting achievement differences in both the sample as a whole and the sub-sample of predominantly-black schools included quadratic (squared) and other non-linear terms involving poverty or poverty-related characteristics of the census tracts included in the study. For example our best equation included data on the square of the variable Per Cent Families Three Times or More Above Low-Income Level.

The utility of quadratic and other non-linear terms in adding to the prediction of achievement in our fourth-count regression equations suggests--depending on the variable--either that students in neighborhoods with a particularly low incidence of poverty and its correlates score higher than predicted or that students in neighborhoods with a paeticularly high incidence of poverty score lower than predicted, or both. (Squared and other non-linear items we used improved prediction by "picking up" effects associated with departures from linearity both at the top and the bottom end of the distribution of achievement scores, depending on the variables.) As in the case of interaction terms, this interpretation must be treated with some caution inasmuch as the non-linear terms in our equations actually may be reflecting variance associated linearly with other predictor variables not included or available in the study or may be reflecting floor or ceiling effects in the variables. Nevertheless, the utility of the non-linear terms in adding variance accounted for after more than eighty percent in some cases already had been explained does suggest that students in relatively wealthy or depressed neighborhoods tend to achieve above or below the levels predicted on the basis of a linear relationship between achievement and the social-economic characteristics of their neighborhoods.

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3. Threshold Points of Achievement

One of the potentially most damaging effects of living in a big city neighborhood with a high concentration of low-income population involves the possibility that the school and other institutions may not function successfully in serving clients with relatively few economic, political, and social resources. Dailey, for example, found that juvenile delinquency rates accelerated noticeably among students in Washington, D. C. schools in which 90 percent or more of the fourth graders were below national norms in reading.[37] This type of finding suggests that there may be "threshold" points beyond which the school or other institutions tend to be ineffective in the face of a particularly high incidence of problems which their staff members are not prepared to handle.

Definite indications of "threshold points" beyond which school programs appear to be largely unsuccessful were found in both our third- and fourth-count data on elementary school achievement in Chicago. These "points" generally shaped the non-linear relationships we sometimes found between census variables and achievement; hence it is possible that they reflect primarily the "ceiling" and/or "floor" effects referred to earlier. Nevertheless, they also suggest that critical levels may exist above or below which achievement tends to be uniformly high or low. Stated differently, our data suggest that grade-level achievement averages tend to be consistently depressed or elevated in communities above or below certain critical threshold levels on variables included in the 1970 census. Several such threshold points are illustrated in Figures 1 through 3.

Figure 1 provides a plot of the scores on 1969-1970 Q2 sixth-grade reading achievement and Per Cent Families Receiving Public Assistance for the schools in the total sample (N = 114). As shown in the figure, none of the forty schools serving neighborhoods in which nine percent or more of the families received public assistance had reading scores above the 31st percentile. This finding suggests that Chicago elementary schools were not very successful in 1969-1970 in teaching reading to pupils in neighborhoods in which this high a proportion of the population received public assistance.

Similarly, Figure 2 shows that none of the forty-one schools serving neighborhoods in which 12.5% or more of the families are headed by females below the poverty level receiving public assistance scored above the 31st percentile on the 1969-1970 Q2 reading achievement at the sixth grade. Based on these plots, it appears that elementary schools in Chicago are not very successful in teaching reading in communities in which approximately a tenth or more of the families receive public assistance and/or are headed by females below the poverty level. In this sense one can say that a threshold level of approximately ten percent may exist on these variables beyond which no schools in our sample were functioning very successfully.

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[37] John T. Dailey, Evaluation of the Contribution of Special Programs in the Washington, D. C. Schools to the Prediction Prevention of Delinquency. Washington, D. C.: George Washington University, 1966. ED 010 431.

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Figure 1. Per Cent Families Receiving Public Assistance and Median Sixth Grade Reading Achievement Percentiles (114 Schools)

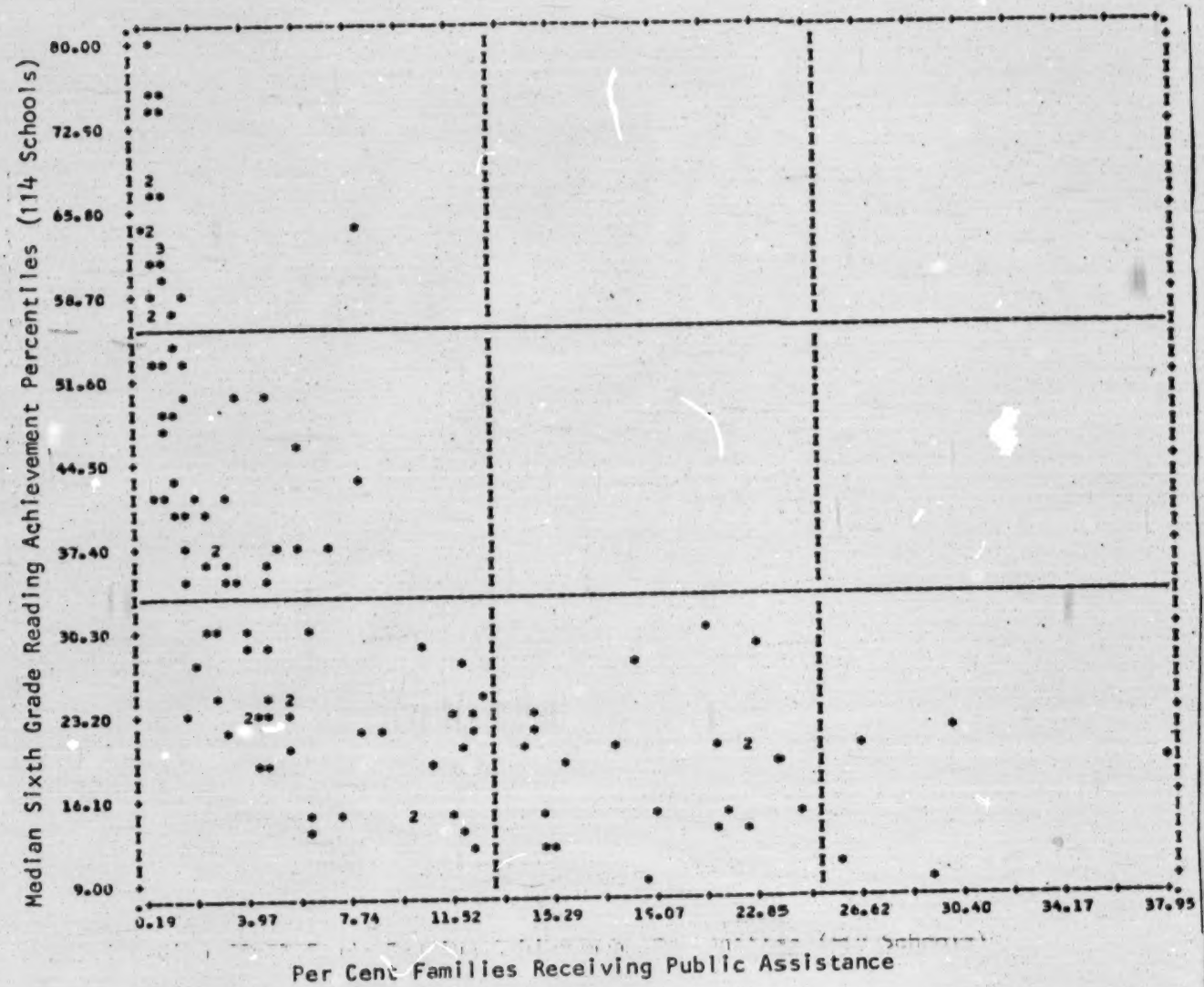

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Figure 2. Per Cent Families with Female Heads and Below Poverty Level and Median Sixth Grade Reading Achievement Percentiles (114 Schools)

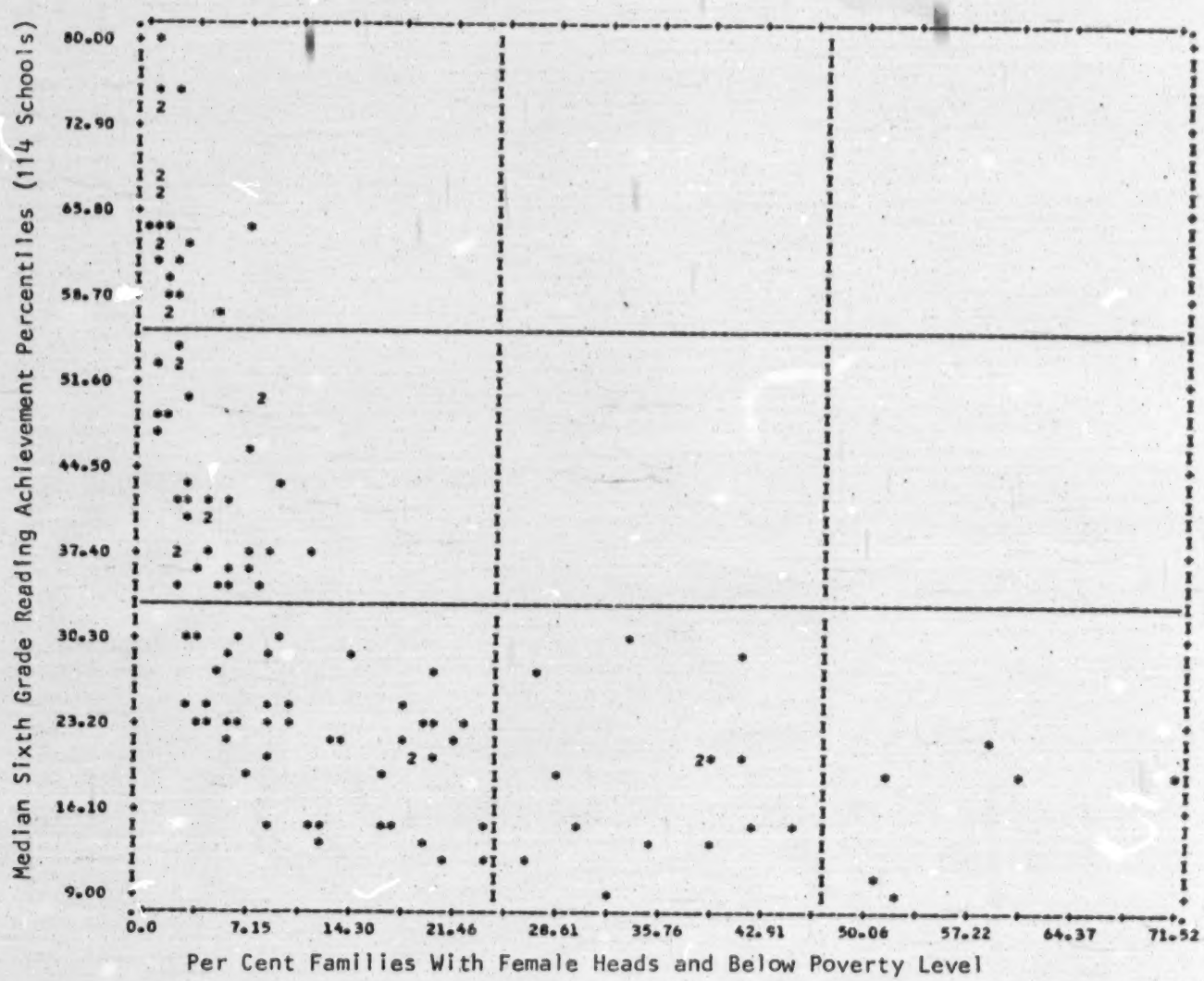

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Figure 3 Per Cent Families Three Times or More Above Low-Income Level and Q3 Sixth Grade Reading Achievement Percentiles (114 Schools)

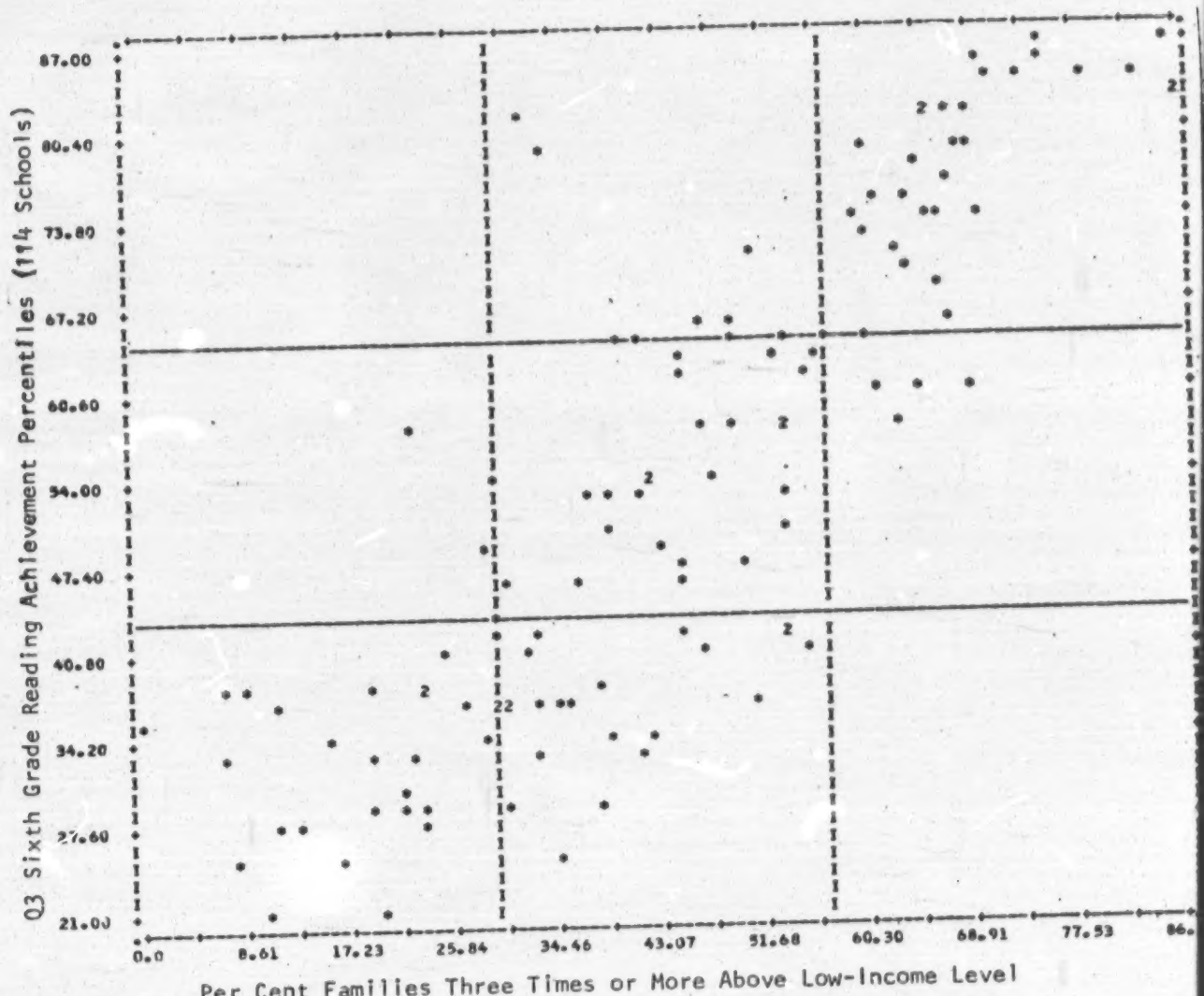

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Figure 3 indicates that threshold points may operate in a "high" as well as a "low" direction among elementary schools in a big city. As shown in the plot, none of the thirty-five schools serving neighborhoods in which approximately sixty percent or more of the families were three times or more above the poverty level had Q3 reading achievement scores below the 58th percentile in 1969-1970 (N = 122). This type of finding suggests that the schools in our sample had little trouble helping most children develop their reading skills in neighborhoods in which at least half the families were high in income and related social and economic resources, perhaps because children in these neighborhoods possess various advantages associated with high reading achievement and their teachers have been prepared and are able to work successfully with the large majority of them.

Concentrated Poverty Neighborhoods

By studying the relationships between 1970 census data and achievement in our sample of Chicago elementary schools, we were able to identify several variables which tend to be associated with low achievement when a school neighborhood fell beyond a crucial threshold point on the variable in question. As shown above, these variables included per cent receiving public assistance and per cent below the poverty level. The same tendency was found with respect to per cent of population in residential structures with 5 or more units as well as a number of alternate measures of low social status.

Taken together, our findings suggest that achievement averages tend to be uniformly low in older and denser[38] neighborhoods with high proportions of low-income, female-headed families which are disadvantaged in terms of economic and social resources. Large neighborhoods of this type--concentrated urban poverty neighborhoods indexed in terms of a high incidence of low-income families and social disorganization--are commonly found in many older and larger cities in the United States. We believe that the relationships we found between concentrated urban poverty and school achievement probably exist in many other cities, but additional research elsewhere would be needed to establish this conclusion.

That special educational disadvantages associated with living in concentrated poverty neighborhoods in big cities may be very widespread is suggested, however, by a recent government report re-analyzing data from the 1966 survey on Equality of Educational Opportunity. Following extensive regression analyses of the data, Mayeske, et al., reported that the independent relationship between family structure and school achievement among black students was higher in the metropolitan north than in the non-metropolitan north or the south.[39] Since black students in the north tend

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[38] The correlation between Per Cent Residential Structures with 5 or More Units and Per Cent Persons in Units with 1.51 or More People Per Room among our school neighborhoods was .54.

[39] George W. Mayeske, et al., A Study of the Achievement of Our Nation's Students. Washington, D. C.: U. S. Government Printing Office, 1973, p. 166.

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to be concentrated in big city neighborhoods with high proportions of poverty-level and female-headed families, this finding suggests the possibility that family structure variables may serve as an index of educational disadvantage contrasting predominantly-black neighborhoods in low-income sections of big cities with those elsewhere in cities or metropolitan areas.

Mayeske, et al. as well as others also have found evidence suggesting that some of the disadvantages associated with living or growing up in concentrated poverty neighborhoods in big cities may be somewhat greater for males than for females. Mayeske, et al., for example, found that the independent relationship between family structure and achievement was greater for black males in the metropolitan north than the non-metropolitan north, while the reverse was true for females.[40] Although the analysis was very complicated and must be interpreted cautiously, this finding suggests that males in big city poverty neighborhoods may be more directly affected adversely by living in these neighborhoods than are females, at least in terms of achievement in school. If so, such a finding in turn may be related to a differential tendency for males to participate earlier and more frequently or more intensively than females in the "street culture" of these neighborhoods.[41]

It is important to emphasize that discovery of a relationship between female-headed families in urban poverty settings on the one hand and low school achievement or alternate indices of institutional failure on the other does not in itself indicate that female-headed families in these neighborhoods are somehow "inadequate" or "inferior." As pointed out by Robert B. Hill of the National Urban League, such statistics do not necessarily support "the view of the Negro family as a causal nexus in a tangle of pathology which feeds on itself. Rather, we view the Negro fairly in theoretical perspective as a subsystem of the larger society."[42]

A statistical study such as our own, which is based on geographic aggregates, can indicate that students achieve poorly in neighborhoods with a high incidence of poverty and social disorganization; it does not show that students in female-headed families in these neighborhoods achieve

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[40] Ibid.

[41] Labov and Robins found that "membership in the street culture" was highly related (negatively) to success in reading among a sample of 10-12 year-old males in an urban ghetto. William Labov and Clarence Robins, "A Note on the Relation of Reading Failure to Peer-Group Status in Urban Ghettoes," Teachers College Record, v. 70, no. 5, 1969, 395-405.

[42] "National Urban League Study - The Strengths of Black Families," Congressional Record - Extension of Remarks, August 6, 1971, E 8985.

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better or worse than those from intact nuclear families. The results can be interpreted as easily and validly to suggest that many youngsters suffer educational disadvantages associated with environmental conditions in neighborhoods with high proportions of female-headed families as to indicate that female-headed families directly "cause" low achievement.

While the literature dealing with the effects of growing up in a female-headed family and/or in a disadvantaged environment in general is ambiguous and is too large to review here, we can note that many studies do support an interpretation emphasizing neighborhood environment in addition to individual family effects. Mayeske, et al., for example, found that "membership in a disadvantaged racial-ethnic group is a handicap that cannot usually be overcome even by intensive educationally related child rearing activities on the part of parents or parental surrogates."[43]

Our own data suggest that residence in a neighborhood characterized by concentrated poverty and its correlates (e.g. high density, social disorganization) is associated with low school achievement independent of low social status (or its various components) per se. Since residence in concentrated poverty neighborhoods in Chicago is closely associated with minority racial-ethnic membership, the difficulties inner city black children frequently seem to experience in programs aimed at overcoming educational disadvantage through "intensive" educational practices in the home or the school may well be attributable more to the overall quality (or lack of quality) of the neighborhood environment than to allegedly-deficient socialization environments in individual families or classrooms. Detrimental neighborhood environments as defined in terms of the kinds of variables considered in this study may turn out to constitute the most important stumbling block in efforts to improve the effectiveness of schools and other social systems in big cities.

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[43] Mayeske, op. cit., p. 132.

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APPENDIX A1

Unstandardized Regression Coefficients (b), F Values, and Squared Multiple Correlations for Eight Census Variables and 1969-1970 First Grade Readiness (114 Schools)

	Variable	b	F	R^2
1.	Units with 1.5 People per Room (logged)	-8.6769	14.51	.61
2.	Three Times Above Low-Income Level (squared)	.6150	3.34	.63
3.	Males Not in Labor Force (square root)	-9.5151	11.27	.69
4.	Moved Since 1967	-.2960	3.87	.73
5.	High School Graduates, Females	-.4333	2.77	.74
6.	Professionals and Managers, Males (square root)	2.9964	3.36	.74
7.	Females 16-21 Unemployed	-.0193	0.10	.74
8.	Female Head Families	.3323	3.99	.74

*Squared multiple correlations have not been corrected for sample size.

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APPENDIX A2

Unstandardized Regression Coefficients (b), F Values, and Squared Multiple Correlations for Eight Census Variables and 1969-1970 Sixth Grade Q2 Reading Achievement (114 Schools)*

	Variable	b	F	R^2
1.	Units with 1.5 People per Room (logged)	-5.5481	13.97	.71
2.	Three Times Above Low-Income Level (squared)	.9214	11.51	.81
3.	Males Not in Labor Force (square root)	-.6924	.15	.81
4.	Moved Since 1967	-.0681	.56	.81
5.	High School Graduates, Females	-.1411	1.03	.81
6.	Professionals and Managers, Males (square root)	.8217	.16	.82
7.	Females 16-21 Unemployed	-.1745	5.65	.82
8.	Female Head Families	.1022	.62	.83

*Squared multiple correlations have not been corrected for sample size.